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Do Bank Holding Companies Act as "Sources of Strength" for Their Bank Subsidiaries?

THOSE WHO WISH to determine why banks fail typically focus on the characteristics of banks and their local markets that make them vulnerable to losses.[1] A key factor often overlooked, however, is capital injections by shareholders. A bank whose losses exceed its capital need not fail, if its shareholders (existing or new) inject sufficient additional funds to restore its capital ratio to a level acceptable to the bank's supervisory agency. Likewise, the shareholders of a bank with a positive, but relatively low, capital ratio can always remove it from its "problem bank" status by injecting sufficient capital.

The 1980s were marked by large numbers of bank failures and large shares of commercial bank assets written off as losses compared with the previous four decades. Taking advantage of this opportunity for comparison, this paper focuses on the incentives of bank holding companies (BHCs) relative to those of other investors to inject additional capital into troubled banks. We test the hypothesis that capital injections into troubled bank subsidiaries of BHCs are larger than the capital injections into troubled independents.

The hypothesis underlying this study is that BHCs have strong incentives to maintain "favorable" reputations in the financial markets and with the Federal Reserve Board (Board). In particular, BHCs want to maintain favorable reputations with the Board because, under general criteria specified in the Bank Holding Company Act, the Board has the authority to approve or deny applications by BHCs to acquire additional subsidiaries. If BHCs inject relatively more capital into their troubled banks, then it is argued that, at least compared to owners of independent banks, BHCs are "sources of strength" for their bank subsidiaries. If BHC affiliation has no influence on the amount of capital injected into troubled banks, then BHCs provide no more support in this form for their subsidiary banks than other bank owners.[2]

[1]Bovenzi, Marino and McFadden (1983) and Demirgüc-Kunt (1989).

[2]Other types of BHC actions to aid troubled bank subsidiaries, such as providing new management, are not considered in this paper. Thus, BHCs may be sources of strength in other ways, even if they do not inject more capital into their troubled banks than other bank owners.

THE "SOURCE OF STRENGTH" PRINCIPLE: A GENERAL DISCUSSION

The Federal Reserve Board issued a statement on April 22, 1987, about the obligations of BHCs toward their troubled bank subsidiaries. In summary, it said:

> The statement reaffirmed a long-standing Board policy that holding companies should use their available resources to provide adequate capital funds to their subsidiary banks during periods of financial stress or adversity. The Board issued the policy statement to remind holding companies of its expectation that they provide financial and managerial strength to their subsidiary banks.[3]

BHCs may take various types of actions to aid their troubled bank subsidiaries besides capital injections. This statement, however, indicates that the Board expects BHCs to employ this method of assistance if losses reduce the banks' capital ratios below acceptable levels.

The Board also has cited the principle of source of strength in denying some applications for the formation of BHCs. In these cases, the Board projected that the dividends from bank subsidiaries necessary to sevice the debt of the new BHCs would reduce the capital ratios of the acquired banks to unacceptably low levels.[4]

The Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA) makes a weaker version of the source-of-strength principle a legal requirement for multi-bank holding companies that own both solvent and insolvent subsidiary banks. FIRREA requires that multi-bank holding companies use the capital of their subsidiary banks to cover the losses of each individual bank subsidiary. Thus, it has eliminated the option of a multi-bank holding company to abandon an individual subsidiary bank, thereby leaving its negative net worth to be absorbed by uninsured depositors or by the Federal Deposit Insurance Corporation while retaining its solvent bank subsidiaries. FIRREA does not require BHCs to use the capital of the parent organization or nonbank subsidiaries to cover negative net worth of their bank subsidiaries. The Federal Reserve Board's standard for "source of strength," although not a legal requirement, covers a broader range of circumstances, including those in which the capital of a BHC's subsidiary bank, after absorbing losses, is low but still positive. Also, the Board expects BHCs to use all of their resources to aid their troubled bank subsidiaries, not just the capital of their bank subsidiaries.

THE GENERAL HYPOTHESIS AND ITS IMPLICATIONS

This paper investigates banks whose recent losses are so large that they must either receive capital injections or reduce their assets to meet the minimum capital standards. During 1985-88, the years covered by this study, the minimum capital requirements of commercial banks were specified in terms of the ratio of their primary capital to their total assets. The major components of primary capital are (1) equity capital (investment by shareholders plus retained earnings) and (2) loan loss reserve.

The minimum requirements set by the federal supervisory agencies for all banks in 1985 called for primary capital to be greater than or equal to 5.5 percent of total assets. The supervisory authorities indicated that even higher capital ratios would be required for banks whose assets were of relatively poor quality.[5] Since the banks in this study incurred large losses relative

[3]Board of Governors (1987), pp. 71-72. See Duncan (1987) and Bureau of National Affairs (1987) for legal interpretations of the Board's statement. The Board also attempted to force MCorp to act as a source of strength for its bankrupt subsidiaries. See Bureau of National Affairs (1989). In mid-May 1990, the Fifth Circuit U.S. Court of Appeals ruled against the Federal Reserve in its suit against MCorp. See Quint (1990). Despite this ruling, BHCs still have incentives to maintain their reputations in financial markets, and the Federal Reserve still has authority to approve or deny any subsequent BHC applications.

[4]These denials are based on projections of the payments necessary to service the acquisition debt and the earnings of the banks to be acquired, not on the records of the BHCs in acting as sources of strength in the past. For a recent case in which the Board applied this principle in denying an application by a BHC, see the *Federal Reserve Bulletin* (April 1990), pp. 257-58.

[5]Gilbert, Stone and Trebing (1985). The bank supervisory authorities also specified a minimum ratio of total capital to total assets of 6 percent. Total capital includes primary capital plus long-term debt of the bank that is subordinated to its deposits. This paper does not consider the adequacy of the total capital ratio or the incentives for banks to issue subordinated debt to meet the total capital ratio.

to their capital, their minimum primary capital ratio is assumed to be 6 percent.[6]

Capital injections into independent banks generally involve the sale of additional bank stock to existing or new shareholders. BHCs that own their bank subsidiaries outright, however, often inject capital into them directly, leaving the number of shares outstanding unchanged.[7] When a BHC injects capital directly, the transaction has the following effects on the balance sheet of the BHC: a reduction in "cash" and an increase in another category of assets called "investment in subsidiaries." On the subsidiary's balance sheet, the transaction involves an increase in both its cash and its "equity capital." In this paper, capital injections are measured as the sum of funds raised by issuing additional shares and injecting capital directly.

BHCs and the Source of Strength Hypothesis

BHCs have reasons to inject capital into their troubled subsidiaries over and above those that apply to individuals who own shares in troubled independent banks. These reasons differ somewhat depending on whether the subsidiary would actually fail or simply have low but positive capital ratios without a capital injection.

First, consider the incentives of BHCs. BHCs wish to convince financial market participants that they are strong, reliable organizations, in order to reduce their borrowing costs and possibly boost the price of their stocks. In several cases, BHCs have covered the losses of their subsidiaries' creditors just to maintain their reputations in the financial markets.[8] As previously discussed, BHCs also are concerned about their reputations with the Federal Reserve Board. Their ability to acquire subsidiaries could be jeopardized if the Board views their failure to support subsidiaries as a lack of willingness to act as sources of strength.

Of course, individuals who own banks also are concerned about their reputations with investors and with bank supervisors. The failure of their banks will make it more costly for them to raise funds in the future to buy other banks. In fact, individuals with poor reputations with bank supervisors may be barred from buying banks.[9] Thus, whether BHCs have greater incentives to recapitalize their troubled banks than individuals who own troubled independents is an empirical issue.

Up to now, the discussion has focused on banks that would fail without capital injections. Most banks in this study, however, had positive primary capital after absorbing their losses, even without capital injections. These banks can raise their capital ratios by reducing their assets or receiving capital injections. BHCs also have reasons for injecting capital into these banks that may not apply to individuals who own stock in troubled independents. Increases in the capital ratios of their subsidiary banks achieved through reductions in assets, rather than by injections of capital, may not demonstrate the BHCs' ability and willingness to act as sources of strength.[10] Thus, if BHCs do not inject additional capital, they may be denied permission to acquire additional subsidiaries in the future.[11]

[6]Losses recognized in the current year reduce primary capital, since they reduce either the loan loss reserve or equity capital. Loans that are not collectible are declared loan losses by bank management and charged against the loss reserve, thereby reducing that component of primary capital. A bank increases its loan loss reserve in the current year though an expense item that is charged against current income. Negative earnings in the current year, perhaps because of a relatively large provision for loan losses, reduce equity capital.

[7]A BHC would inject capital into a bank subsidiary rather than buy additional shares only if it owned all of the bank's stock. Otherwise, a direct injection of capital is a gift to other shareholders that increases the value of their shares even though they have not increased their investment in the bank.

[8]For a description of cases in which BHCs covered the losses of their subsidiaries, rather than forcing the creditors of their subsidiaries to absorb them, see Cornyn, et al (1986), pp. 187-91. The authors interpret these actions as attempts by BHCs to portray themselves as strong, reliable organizations that honor their obligations.

[9]Individuals must apply to the supervisory authorities for permission to buy controlling interest in banks. If individuals refuse to inject capital into their failing banks, the supervisory authorities may block their acquisitions of banks in the future. See Spong (1985), pp. 94-95.

[10]The Board's record in acting on BHC applications to acquire subsidiaries makes it difficult to provide a more definitive description of the Board's standards for source of strength. In most cases in which the Board has stated the principle of source of strength as the basis for denials, the basic issue is excessive debt in the formation of one-bank holding companies. Few denials have been based on the failure of BHCs to act as sources of strength for their bank subsidiaries.

[11]Note that the Board statement quoted above refers to the use of "available resources to provide adequate capital funds to their subsidiary banks during periods of financial stress or adversity." This statement could be interpreted as indicating that a BHC would not be considered a source of strength if it fails to inject capital into a subsidiary bank with a low but positive capital ratio.

The Issue of Size

BHCs differ greatly in terms of the magnitude of their assets and the number of their subsidiaries. Many BHCs, for example, have only a single subsidiary. The incentives for the owners of such a one-bank holding company to inject capital into their troubled subsidiary are likely to be similar to those of individuals who own a troubled independent. The failure of a BHC's sole subsidiary would have no adverse effects on the BHC's cost of funds because it would be out of business as well. Moreover, a BHC with only one subsidiary has certainly not shown that it considers permission to acquire additional subsidiaries to be a valuable privilege.

For multi-bank holding companies, the incentive to inject capital is presumably greater, the larger are the total assets of all subsidiaries in the BHC to the assets of its troubled subsidiary. The prospective penalties imposed on a BHC by both the financial markets and the Board for a failure to inject capital into a troubled subsidiary are likely to be positively related to the total assets of the BHC.[12] Thus, in modeling the determinants of capital injections into troubled banks, variables designed to reflect affiliation with BHCs reflect the assets of BHCs relative to the assets of their troubled bank subsidiaries.

Assessing the Financial Strength of BHCs

Capital injections by BHCs also are assumed to be influenced by their own financial conditions. If primary capital ratios at the other banks in a BHC exceed the levels required by bank supervisors, the BHC can channel capital from them, via dividends, to the troubled subsidiary. Alternatively, a BHC with most of its subsidiaries in strong financial condition could raise funds in the financial markets at lower interest rates (reflecting lower risk premiums) than BHCs that have larger numbers of troubled banks.

In contrast, if the primary capital ratios of the banks in a BHC are generally below required levels, banks have little or no excess capital to pay out as dividends to the BHC to channel to its more troubled subsidiaries. Moreover, such a BHC would have less incentive to promote its reputation with the Board as a source of strength by attempting to come to the aid of one of its bank subsidiaries; the relatively low capital ratios of its other subsidiaries clearly indicate that the BHC is not in a position to act as a source of financial strength.

A FORMAL SPECIFICATION OF THE BANK CAPITAL INJECTION MODEL

Equation 1 presents the model of the determinants of capital injections into troubled banks used in this study.

$$(1)\quad INJ = f(\overset{+}{RHCS10},\ \overset{+}{RHCS50},\ \overset{+}{RHCS100},\ \overset{+}{RHCS100+},\ \overset{+}{FSHC},\ \overset{+}{NINJ},\ \overset{+}{ROA})$$

The variables used are defined below: the signs above the variables in equation 1 show the expected signs of their estimated coefficients.

INJ = the ratio of the capital injected into a bank to the total assets of the bank at the end of the prior year.

RHCS10 = dummy variable with a value of unity if the ratio of total banking assets of a BHC to the assets of its troubled bank subsidiary (RHCS) is greater than unity but less than 10, zero otherwise.

RHCS50 = dummy variable with a value of unity if RHCS is greater than or equal to 10 but less than 50, zero otherwise.

RHCS100 = dummy variable with a value of unity if RHCS is greater than or equal to 50 but less than 100, zero otherwise.

RHCS100+ = dummy variable with a value of unity if RHCS is greater than or equal to 100, zero otherwise.

FSHC = the ratio of the sum of primary capital of banks in the BHC, other than the troubled banks included in this study, to the sum of their total assets.

NINJ = the ratio of the capital injection necessary to make primary capital equal to 6 percent

[12]While it is impossible to determine the value of future acquisitions to a BHC without knowing its plans, a reasonable guess might be that BHCs that have grown large through acquisitions would place higher value on the privilege to make additional acquisitions than BHCs that have made fewer acquisitions. Under this assumption, the penalty for not investing in a troubled subsidiary in the form of foregone opportunities for future acquisitions is proportional to the total assets of the BHC.

of total assets as of the end of the prior year, to their total assets at the end of the prior year.

ROA = the ratio of net income of the banks in the county of a troubled bank, other than the troubled bank itself, to their total assets. Income is measured over the calendar year prior to the year in which the bank becomes a troubled bank, and total assets are measured at the end of that year.

Identification of Troubled Banks and the Measure of Capital Injections

Equation 1 is designed to explain capital injections into a specific group of banks — those whose primary capital ratios initially exceeded 6 percent but who had losses in the current year that drove their primary capital below 6 percent. To raise their capital ratios up to 6 percent, these banks must receive capital injections or reduce their assets. The capital injected into each bank is measured as the sum of capital injections over four quarters, beginning in the quarter in which the losses reduced their primary capital below 6 percent of their total assets in the initial period.

Each bank included in the study had, at the end of the prior year, primary capital that exceeded 6 percent of its total assets, as illustrated in inequality 2.

(2) $0.06A_0 < C_0$,

where

A_0 = total assets in the last quarter of the prior year,

C_0 = primary capital in the last quarter of the prior year.

Then, during some quarter of the current year, each bank in the study had losses sufficient to reduce its primary capital (net of any capital injection in that quarter) below 6 percent of its total assets at the end of the prior year (A_0), as illustrated in inequality 3.

(3) $0.06A_0 > [C_t - I_t]$,

where

C_t = primary capital in the first quarter of the current year (quarter t) in which this inequality holds,

I_t = capital injections in the first quarter of the current year (quarter t) in which this inequality holds.

Capital injections in quarter t are subtracted from the right side of inequality 3 because some banks inject capital immediately to cover at least part of their losses; in fact, if they inject enough capital, their primary capital would not actually fall below 6 percent of A_0. Yet these banks should be included in the analysis because they received large capital injections to offset large losses.

In deriving values of the dependent variable, capital injections are summed over four quarters, primarily because of the typical timing of the capital injections. Most capital injections occurred in the fourth quarter of the year in which losses reduced the primary capital of a bank enough to satisfy inequality 3. Of the 256 banks in this study that received capital injections, 238 received capital injections during this quarter, regardless of the actual quarter in which the inequality first held. Moreover, 221 of these received their only capital injection in that fourth quarter. Given this timing, a four-quarter period starting with the quarter in which each bank satisfies inequality 3 is adequate for examining capital injections into troubled banks. Thus, capital injections are measured as the sum of capital injections in quarter t through t+3. The equation for calculating the dependent variable, INJ, is specified in equation 4:

(4) $$INJ = \sum_{j=0}^{3} I_{t+j}/A_0$$

Because the capital injections are summed over four quarters, an additional constraint is imposed on the balance sheets of the banks included in this study: their primary capital in quarter t+3 (net of capital injections in quarters t through t+3) *must* be less than 6 percent of A_0, their total assets at the end of the year before their large losses. This is because banks may have increased their primary capital in quarters t+1 through t+3 in ways that do not involve explicit capital injections; among these are positive earnings that are retained, recoveries on loans previously charged off as losses and changes in accounting practices. Such changes in primary capital after quarter t will affect the amount of capital injections needed to meet their capital requirements. This condition is stated in inequality 5:

(5) $$0.06A_0 > [C_{t+3} - \sum_{j=0}^{3} I_{t+j}].$$

Finally, some banks that satisfy inequalities 3 and 5 are excluded from this study because they were involved in mergers or were purchased by new owners around the time of their losses.[13] Including these banks would have potentially biased the results of this study. Suppose, for instance, that troubled banks sold to new owners are acquired by BHCs that injected additional capital into their new bank subsidiaries. Including these banks in the study would exaggerate the significance of BHCs as sources of strength for their existing bank subsidiaries.

In deriving the dependent variable, INJ, the dollar value of capital injections is divided by A_0 to create a measure of capital injections that is unaffected by contemporaneous changes in total assets. Using the total assets existing when the capital injections were made could bias the estimate of the effects of affiliation with BHCs on the size of capital injections.

Suppose, for example, that BHCs inject enough capital into their troubled subsidiaries to meet capital requirements without reducing their assets, while shareholders of independent banks choose combinations of capital injections and reductions in assets. Deflating capital injections by the total assets when such injections are made would bias downward the estimate of the effect of affiliation with BHCs on the size of capital injections. Deflating by A_0 avoids this potential bias.[14]

Relative Size of BHCs and Their Troubled Bank Subsidiaries

Equation 1 includes dummy variables for different levels of RHCS — the ratio of the total banking assets of the BHC to the assets of its troubled subsidiary. These dummy variables apply only to multi-bank holding companies. No subsidiaries of one-bank holding companies are included in the study because all that met the inequality conditions were sold around the time they became troubled banks.

If BHCs as a group inject more capital into their troubled bank subsidiaries than other bank owners, the coefficients on the dummy variables for RHCS will be positive and statistically significant. Moreover, as explained previously, the coefficients are expected to be larger for higher values of RHCS.

Financial Strength of the BHC (FSHC)

FSHC reflects the financial strength of BHCs; it is measured as the ratio of the primary capital of the banking subsidiaries of a BHC — other than that of their troubled bank subsidiaries in this study — to their total assets. The primary capital and total assets values used are those in the fourth quarter of the year prior to the year in which the subsidiary first satisfies inequality 3. For troubled banks that are not subsidiaries of BHCs, FSHC has a value of zero.

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[13]The following rules are designed to exclude banks that were sold to new owners around the time they became troubled banks. Each bank that was a subsidiary of a BHC in 1985 must have been a subsidiary of the same BHC in December 1983. Similarly, banks that were not affiliates of BHCs in 1985 must also have been independent banks in December 1983. In a similar fashion, subsidiaries of BHCs included in the study for 1986 were affiliates of the same BHCs as of December 1984 or were independent banks in both periods. The rules for including banks in the study for 1987 and 1988 have similar timing.

Troubled independent banks that were sold to new owners are not excluded from the study because it is more difficult to obtain information on their ownership than on that of BHCs. There are 113 banks that met the other criteria for inclusion in the study that were excluded because of changes in their ownership around the time they became troubled banks. These 113 include 24 in which multibank holding companies bought troubled independent banks. The multibank holding companies injected capital into 19 of these banks.

[14]The possible distortions that would result from scaling capital injections by total assets as of the time of the capital injections can be illustrated by considering two banks that are identical in every way other than the response of their shareholders to losses. In December 1984, Bank A and Bank B had primary capital of $6 and total assets of $100. In the first quarter of 1985, each had a loss of $2, reducing primary capital to $4 and total assets to $98. For the rest of 1985, loan losses and net income were zero for each bank. During 1985, shareholders inject $2 into Bank A, returning primary capital to $6 and total assets to $100. Bank B receives a capital injection of $1 during 1985 and reduces its assets by $15, raising its primary capital ratio to approximately 6 percent [5/(100—2 + 1—15) = 0.0595].

Since the capital injection into Bank A is twice that for Bank B, the value of the dependent variable should be twice as large for Bank A. If capital injections were deflated by total assets as of the time of the capital injections, however, the ratio would be 0.02 for Bank A (2/100) and 0.0119 for Bank B (1/84).

Capital Injection Necessary to Maintain the Prior Level of Total Assets (NINJ)

NINJ is defined and calculated as the capital injection necessary to raise the troubled bank's primary capital to 6 percent of A_0 divided by A_0.[15] The calculation of the values of NINJ is illustrated in equation 6:

$$(6)\quad NINJ = 0.06 - [C_{t+3} - \sum_{j=0}^{3} I_{t+j}]/A_0.$$

NINJ is included as an independent variable in the equation for capital injections to avoid possible biases in estimating the effect of BHC affiliation on capital injections. For instance, suppose that BHC subsidiaries require capital injections of 4 percent of total assets (A_0) to meet their capital requirements without reducing their assets, while independent banks need only 1 percent. Including the independent variable NINJ controls for such differences.

Expected Future Profits

Bank losses may cause shareholders to lower the future profits they expect their banks to earn for a given level of assets, making them reluctant to add capital into these banks. Alternatively, their expected profits may be unaffected by current losses; in these cases, current shareholders may add capital to offset part or all of the reduction in primary capital.

The average rates of return on assets (ROA) of other banks in the counties of the troubled banks are used to indicate the prospects for future profits. ROA is included to determine whether shareholders of troubled banks located in areas in which other banks have achieved relatively high ROA are more likely to inject capital into their banks.

THE DATA

Location and Size of the Banks

The study includes all banks located in the 20 states in table 1 in the years 1985-88 that meet the various criteria. These 20 states permit multibank holding companies but do not permit statewide branching. The restriction on statewide branching is important for the construction of ROA, since data on the profit rates of individual branches are not available.

Table 1

Distribution of Troubled Banks by Year and Location

Year[1]	Texas	Other states[2]	Total
1985	35	80	115
1986	115	93	208
1987	134	67	201
1988	90	44	134
Total	374	284	658

[1]Year in which bank first satisfied inequality 3 in text.

[2]The other states are Arkansas, Colorado, Georgia, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Montana, New Mexico, North Dakota, Ohio, Pennsylvania, Tennessee, West Virginia, Wisconsin and Wyoming.

Information in table 1 highlights the deteriorating condition of banks in Texas over the period. In 1985, about 30 percent of the banks in the study were Texas banks; by 1987 and 1988, about two-thirds of them were located in Texas.

Table 2 shows the asset size of the banks in the study. While the vast majority had total assets under $100 million, a few had total assets in excess of $1 billion.

Distribution of Banks by Capital Injections Necessary to Meet Capital Requirements (NINJ)

The distribution of banks by values of NINJ, the capital injection ratio necessary to raise the primary capital ratio to 6 percent without reducing total assets, is shown in table 3. Of the 658 banks, 76 had such large losses that their

[15]Evidence in other studies is consistent with the hypothesis that capital requirements influence capital injections. Dahl and Shrieves (1990) found that banks with capital ratios below required levels were more likely to receive capital injections than other banks. Mingo (1975) estimated changes in bank equity capital as a function of several independent variables, including the capital requirements of bank supervisors. Capital requirements were significant in explaining changes in equity capital. Wall and Peterson (1987, 1988) reported that changes in the equity capital ratios of banks were influenced predominantly by capital requirements of bank supervisors. These studies are consistent with the hypothesis that capital requirements influence capital injections by bank shareholders.

Table 2
Distribution of Troubled Banks by Asset Size

Assets (millions of dollars)	Texas		Other States	
	Number	Percentage	Number	Percentage
Assets < $25	119	31.8%	140	49.3%
$25 ≤ Assets < $50	117	31.3	72	25.4
$50 ≤ Assets < $75	54	14.4	29	10.2
$75 ≤ Assets < $100	27	7.2	11	3.9
$100 ≤ Assets < $1,000	49	13.1	31	10.9
$1,000 ≤ Assets	8	2.1	1	0.4
Total	374		284	

Table 3
Distribution of Banks by Capital Injection Ratios Necessary to Meet Capital Requirements without Reducing Assets

NINJ	Texas		Other States	
	Number	Percentage	Number	Percentage
0.01 ≥ NINJ > 0	68	18.2%	77	27.1%
0.02 ≥ NINJ > 0.01	66	17.6	77	27.1
0.03 ≥ NINJ > 0.02	72	19.3	40	14.1
0.04 ≥ NINJ > 0.03	55	14.7	29	10.2
0.05 ≥ NINJ > 0.04	34	9.1	25	8.8
0.06 ≥ NINJ > 0.05	23	6.1	16	5.6
NINJ > 0.06	56	15.0	20	7.0
Total	374		284	

primary capital would have been negative without capital injections. At the other extreme, 145 banks required capital injections that were less than 1 percent of their total assets. Table 3 shows that values of NINJ are not clustered at the extreme values.

Affiliation with Bank Holding Companies

Table 4 indicates that about half of the Texas banks and about 56 percent of the banks located in the other states are subsidiaries of multibank holding companies. The rest were independent.

THE RESULTS

Table 4 provides a comparison of the incidence of capital injections into independent banks and subsidiaries of BHCs, ignoring other determinants. The patterns of capital injection frequency over time were different for banks in Texas than for those in other states. For independent banks and subsidiaries of BHCs in Texas, the percentages of banks receiving capital injections declined over time. In each year, however, a higher percentage of BHC subsidiaries than independent banks received capital injections, and the percentages were significantly higher in 1986, 1987 and for the 1985-88 period as a whole.

For banks in other states, there was no consistent pattern over time in the incidence of capital injections. As with the Texas banks, the percentage of banks that received capital injections was higher each year for BHC subsidiaries than for independent banks. The percentages are significantly higher in 1985, 1987 and for the 1985-88 period as a whole. Thus, these direct comparisons show that, in general, a larger proportion of BHC-owned troubled banks received capital injections than did troubled independents.

Table 4
Frequency of Capital Injections into Troubled Banks

	Year[1]				
	1985	1986	1987	1988	1985-88
BANKS IN TEXAS:					
Independent banks					
No. with INJ>0	10	10	10	7	37
Others	10	41	54	44	149
Percentage with INJ>0	50.0%	19.6%	15.6%	13.7%	19.9%
BHC subsidiaries					
No. with INJ>0	10	31	27	9	77
Others	5	33	43	30	111
Percentage with INJ>0	66.7%	48.4%	38.6%	23.1%	41.0%
Percentage significantly higher for BHC subsidiaries[2]	NO	YES	YES	NO	YES
(t-statistic for equality of proportions in parentheses)	(1.01)	(3.45)	(3.11)	(1.13)	(4.55)
BANKS IN OTHER STATES:					
Independent banks					
No. with INJ>0	13	14	11	11	49
Others	25	15	25	12	77
Percentage with INJ>0	34.2%	48.3%	30.6%	47.8%	38.9%
BHC subsidiaries					
No. with INJ>0	30	33	19	11	93
Others	12	31	12	10	65
Percentage with INJ>0	71.4%	51.6%	61.3%	52.4%	58.9%
Percentage significantly higher for BHC subsidiaries[2]	YES	NO	YES	NO	YES
(t-statistic for equality of proportions in parentheses)	(3.58)	(0.29)	(2.64)	(0.30)	(3.42)
BANKS IN ALL 20 STATES:					
Percentage significantly higher for BHC subsidiaries[2]	YES	YES	YES	NO	YES
(t-statistic for equality of proportions in parentheses)	(3.46)	(2.96)	(3.83)	(1.14)	(5.84)

[1]Year in which banks first satisfied inequality 3 in the text.

[2]Percentages are significantly different at the 5 percent level. See Wonnacott and Wonnacott (1990), pp. 273-75.

Estimation of Equation for Capital Injections

The statistically significant differences in table 4 may indicate that BHCs acted as sources of strength for their subsidiaries; on the other hand, these differences may be attributed to other factors not explicitly shown in the table. Equation 1 is designed to indicate whether other determinants of capital injections, in fact, are responsible for the BHC effect on capital injections suggested by table 4.

Equation 1 is estimated using Tobit regression analysis, instead of OLS regression methods, because a large number of the troubled banks had zero capital injections. In the sample used, only 256 of the 658 banks had positive capital injections. The shaded insert discusses the nature of Tobit analysis and explains how to interpret the estimated coefficients.

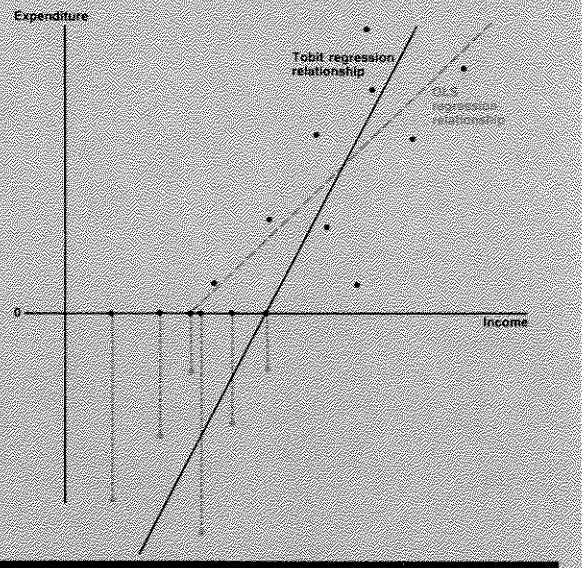
Tobit Regression Analysis

Tobit analysis is appropriate in estimating coefficients using data sets in which large proportions of the observations for the dependent variable are at some limiting value, such as zero. Tobin (1958), who pioneered this type of analysis, estimated the influence of income and other variables on household expenditure on durable goods. A large percentage of households made no durable purchases in the year of the survey. Such a data set is illustrated in figure 1. A possible explanation for the zero expenditures is that, since expenditures on durable goods is not continuous, purchases are not made until the "desire" to buy the goods exceeds a certain level. We cannot observe desires, however; we observe only expenditures. "Negative" expenditures, corresponding to various levels of desire below the threshold level, cannot be observed.

Tobit analysis is used in estimating the determinants of capital injections because a majority of the banks in the study have zero capital injections. This truncation of the dependent variable at zero reflects the effects of regulation. While desired capital injections into many of the banks in the study may be negative, government supervisors restrict dividends (negative capital injections) of banks with negative earnings and capital ratios below the minimum required level.

Estimation of the relationship between expenditures and income with the data in figure 1 using OLS techniques will yield a biased estimate of the relationship between desired expenditures and income. The points represented by circles are the unobserved desired expenditures below the threshold. Those observations are recorded as zero expenditures and positive income, as indicated by the dashed lines. The problem with OLS estimation is illustrated using the following notation: let E_i^* be desired levels of expenditure, E_i the observed levels of expenditure, and I_i household income for the ith household. Equation A1 is the relationship between desired expenditures and income.

Figure 1
Tobit and OLS Regression Relationships



(A1) $E_i^* = \alpha + \beta I_i + \varepsilon_i^*$ (i = 1,2,...,n).

The expected value of ε_i^* is assumed to be zero with variance of σ^2. Equation A2 presents the relationship between E_i and E_i^*

(A2) $E_i = E_i^*$ if $E_i^* > 0$
$= 0$ if $E_i^* \leq 0$.

Equation A3 is that relationship estimated using OLS techniques:

(A3) $E_i = \hat{\alpha} + \hat{\beta} I_i + \varepsilon_i$.

In this equation, $\hat{\beta}$ is a biased estimate of β in equation A1; thus, ε_i would not have an expected value of zero with variance of σ^2.

In Tobit analysis, parameters are estimated using maximum likelihood analysis. The likelihood function has two parts, one for observations with values of the dependent variable at the limiting value, the other for the remaining observations. The computer programs search through several iterations for the values of the regression coefficients that maximize the value of a likelihood function.[1]

The effects of unit changes in independent variables on the dependent variable are es-

[1]See Kmenta (1986), pp. 560-63.

timated using the regression coefficients derived from Tobit regression analysis. Estimates derived from these coefficients alone, however, would overstate the size of the effects. The coefficients must be multiplied by the expected probability that an observation will have a value of the dependent variable other than the limiting value. To illustrate this point, consider the Tobit regression equations estimated in table 7 of the text, which indicate that affiliation with a relatively large BHC has a positive and statistically significant effect on the desired capital injection ratio of a bank. Whether such affiliation has positive effects on observed capital injections depends on the probability that the desired capital injection ratio of a bank will exceed zero. For many of the banks in the study, desired capital injections are assumed to be negative, since their observed capital injections are zero and their dividends are restricted by supervisors. The effects of affiliation with relatively large BHCs on desired capital injections are weighted by the expected probability that capital injections will be positive. This weighting involves multiplying the Tobit regression coefficients by the expected probability that the capital injection ratio *is positive*. The expected probability of a positive capital injection ratio is derived from the Tobit regression equation with the independent variables set equal to their mean values.

Results for the estimation of equation 1 for 1985 through 1988 are presented in table 5. Separate equations are estimated for Texas banks because the substantial deterioration of earnings and capital adequacy of the entire Texas industry in recent years may have influenced Texas shareholders' incentive to inject capital into troubled banks.

The results indicate that the effects of affiliation with BHCs are qualitatively similar for troubled banks whether in Texas or elsewhere. BHC-owned troubled banks do not receive larger capital injections than independent banks, holding constant the other determinants of capital injections, when the total banking assets of the BHCs are less than 10 times the total assets of their troubled bank subsidiaries (RHCS10). In both equations, the coefficients on RHCS100 and RHCS100+ are positive and statistically significant, indicating that if the BHC's total banking assets are at least 50 times as large as the assets of its troubled subsidiary, it injects more capital into the subsidiary than do the owners of independent banks. Outside Texas, this condition also holds for BHCs with total banking assets at least 10 times the assets of their troubled banks' subsidiaries. Thus, the decision to inject capital depends on the size of BHCs relative to the size of their troubled subsidiaries.

The coefficients on the variable NINJ are positive and significant in each equation, as the hypothesis suggested. However, the variable FSHC — the weighted average capital ratio of the banking subsidiaries of BHCs, other than those included in the study — does not help ex-

Table 5

Tobit Regression Results (t-statistics in parentheses)

Dependent variable: INJ

Independent variables	Texas	Other states
Constant	−0.0589** (7.73)	−0.0217** (4.66)
RHCS10	0.0142 (1.49)	−0.0055 (0.88)
RHCS50	0.0109 (0.93)	0.0175** (2.78)
RHCS100	0.0468** (4.07)	0.0275** (3.91)
RHCS100+	0.0192* (2.36)	0.0114* (2.28)
NINJ	0.5867** (5.57)	0.6835** (7.46)
ROA	0.7722* (2.42)	−0.2550 (0.85)
No. of observations	374	284
No. with INJ>0	114	142
Likelihood ratio test statistic	49.94**	79.67**
Predicted probability of INJ>0 with independent variables at mean values	0.2889	0.5137

*statistically significant at the 5 percent level

**statistically significant at the 1 percent level

Table 6
ROA of Other Banks in Same County as Troubled Bank

	1985[1]	1986[1]	1987[1]	1988[2]
Banks in Texas				
Mean ROA	0.0056	0.0054	−0.0012	−0.0097
SD	0.0141	0.0039	0.0071	0.0139
N	35	115	134	90
Banks in other states				
Mean ROA	0.0077	0.0058	0.0047	0.0039
SD	0.0051	0.0072	0.0063	0.0062
N[2]	79	89	65	44

[1]Year in which banks first satisfy inequality 3.
SD — standard deviation
N — number of banks

[2]Data for ROA are missing for a few banks.

plain differences in capital injections among troubled banks. When FSHC was added as an independent variable to the equations in table 5, its estimated coefficient was not significantly different from zero in either equation.

ROA as a Determinant of Capital Injections

The coefficient on ROA is significant for the Texas regression but insignificant in the other. An examination of the ROA variable suggests that this reflects the sharp drop in profitability of Texas banks relative to that at non-Texas banks over the years covered by this study. The decline in profitability among Texas banks (table 6) induced a corresponding decline in capital injections by Texas bank owners (table 4).[16]

Alternative Specification

Table 5 represents one way to assess the impact of BHC affiliation on capital injections into troubled banks. It is possible, however, that the coefficients on dummy variables for the ratio RHCS in fact may reflect more than simply BHC affiliation. Capital injections may actually be influenced by the absolute size of BHCs and, independent of BHC affiliation, by the size of troubled banks themselves. Such separate size effects might well confound the interpretation of the RHCS dummy variables.

Equation 7 examines this possibility by incorporating the asset size of troubled banks and BHCs into the equation:

(7) INJ = f(S50·D1, S75·D1, S75+·D1, S50·D2, S75·D2, S75+·D2, BHC100, BHC1000, BHC1000+, NINJ, ROA).

The additional independent variables are:

S50 — dummy variable with a value of unity if the total assets of the troubled bank are greater than $25 million but less than or equal to $50 million, zero otherwise

S75 — dummy variable with a value of unity if the total assets of the troubled bank are greater than $50 million but less than or equal to $75 million, zero otherwise

S75+ — dummy variable with a value of unity if the total assets of the troubled bank are greater than $75 million, zero otherwise

D1 — dummy variable with a value of unity if a bank is an independent bank, zero otherwise

[16]One way to separate the effects on capital injections of variation in ROA across counties from the effects of changes in average ROA over time is to add dummy variables for individual years as independent variables. In regressions not reported here, dummy variables for individual years are added as independent variables to the equations estimated in table 5. In those regressions, the coefficient on ROA is insignificant for the Texas equation and remains insignificant in the other equation. Thus, after allowing for different capital injection ratios in different years, differences in ROA across the counties in which the troubled banks were located did not help explain differences in capital injection ratios across troubled banks.

D2 — dummy variable with a value of unity if a bank is a BHC subsidiary, zero otherwise

BHC100 — dummy variable with a value of unity if the troubled bank is a subsidiary of a BHC with total banking assets of $100 million or less, zero otherwise

BHC1000 — dummy variable with a value of unity if the troubled bank is a subsidiary of a BHC with total banking assets greater than $100 million but less than or equal to $1 billion, zero otherwise

BHC1000+ — dummy variable with a value of unity if the troubled bank is a subsidiary of a BHC with total banking assets greater than $1 billion, zero otherwise.

Table 7 indicates that capital injection ratios are larger for subsidiaries of the larger BHCs. Among Texas banks, capital injections increase if they are subsidiaries of BHCs with total assets over $100 million. For banks in the other states, capital injections are larger if banks are in subsidiaries with total assets in excess of $1 billion.

The BHC effect on capital injections, however, is not just a matter of BHC size. Table 7 also indicates that, holding constant the size of the BHC, the larger BHC subsidiaries have lower capital injections ratios. Coefficients on dummy variables for the size of independent banks are not statistically significant. Thus, tables 5 and 7 yield the same implications for the effect of BHC affiliation on capital injections: it is the size of BHCs relative to the size of their troubled bank subsidiaries that influences capital injection ratios.

Economic Significance of Affiliation with BHCs for Capital Injections

The empirical results support the hypothesis that BHC subsidiaries receive larger capital injections than other troubled banks. But are the effects of affiliation with BHCs on capital injections large enough to be economically significant? If the BHC effect is estimated to yield only a few extra dollars for a typical troubled bank, the statistically significant effects could be dismissed easily as being economically irrelevant.

Economic significance can be gauged by estimating the difference between the capital injection ratios of a BHC subsidiary and an independent bank with identical values of the other independent variables. These effects could be estimated alternatively using the results in tables 5 or 7. Table 7 is used because its maximum likelihood test statistics are larger, indicating greater explanatory power of the equations.

Estimation of the size of the effect of affiliation with BHCs involves an analysis of the size of the regression coefficient. As explained in the insert on Tobit analysis, the regression coefficients must be multiplied by the probability of the dependent variable being greater than zero (the fraction at the bottom of the table) to estimate the effects of a unit change in an independent variable on the size of the dependent variable. In table 7, the fraction is 0.2817 for the second equation (Texas banks) and 0.5147 for the fourth equation (banks located elsewhere). These equations are used in the analysis of the economic significance of affiliation with BHCs on capital injections.

The estimates of BHC effects on the size of capital injections are presented in table 8. These effects are assumed to be zero unless the regression coefficients are significantly different from zero at the 5 percent level. They are calculated as follows: Suppose a troubled bank in Texas, with total assets of less than $25 million, is a subsidiary of a BHC whose total assets are greater than $100 million but less than or equal to $1 billion. Compared with an independent bank of the same size and characteristics other than BHC affiliation, the capital injection is estimated to be higher at the BHC subsidiary by 1.67 percent of its total assets, which is calculated as 0.0592 (the coefficient on BHC1000) times 0.2817, the adjustment to regression coefficients appropriate for Tobit analysis. The effect for a subsidiary of a BHC of similar size that has total assets between $25 million and $50 million is estimated as follows:

$$(0.0592 - 0.0399)0.2817 = 0.0054.$$

These estimates have a consistent pattern: in a given size range, capital injection ratios are larger for banks that are subsidiaries of larger BHCs, and smaller for larger bank subsidiaries.

The effects of BHC affiliation can be stated in dollar terms by assuming certain asset sizes for the representative BHC subsidiaries. For instance, suppose the troubled bank has total assets of $15 million and is a subsidiary of a BHC with total assets between $100 million and $1 billion. Its capital injection is estimated to be $250,500 larger than that into a similar sized in-

Table 7

Alternative Tobit Regression Results: 1985-88 (t-statistics in parentheses)

Dependent variable: INJ

Independent variables	Texas		Other states	
Constant	−0.0498**	−0.0604**	−0.0217**	−0.0249**
	(6.69)	(9.15)	(4.77)	(5.72)
S50·D1	−0.0179		−0.0094	
	(1.74)		(1.22)	
S75·D1	−0.2314		−0.1385	
	(0.01)		(0.03)	
S75+·D1	−0.2129		−0.1404	
	(0.01)		(0.02)	
S50·D2	−0.0395*	−0.0399*	−0.0058	−0.0057
	(2.45)	(2.44)	(0.86)	(0.85)
S75·D2	−0.0405*	−0.0409*	−0.0150	−0.0147
	(2.32)	(2.30)	(1.77)	(1.72)
S75+·D2	−0.0467**	−0.0470**	−0.0153*	−0.0153*
	(2.90)	(2.88)	(2.07)	(2.04)
BHC100	0.0046	0.0136	−0.0037	−0.0005
	(0.24)	(0.72)	(0.49)	(0.06)
BHC1000	0.0496**	0.0592**	0.0040	0.0073
	(3.19)	(3.85)	(0.49)	(0.92)
BHC1000+	0.0659**	0.0757**	0.0289**	0.0321**
	(3.91)	(4.51)	(4.22)	(4.77)
NINJ	0.5880**	0.6130**	0.7489**	0.7613**
	(5.73)	(5.97)	(8.18)	(8.27)
ROA	0.8513*	0.9090**	−0.1078	−0.2021
	(2.73)	(2.90)	(0.36)	(0.68)
No. of observations	374	374	284	284
No. with INJ>0	114	114	142	142
Likelihood ratio test statistic	78.58**	67.37**	97.71**	89.88**
Predicted probability of INJ>0 with independent variables at mean values	0.2129	0.2817	0.4768	0.5147

* statistically significant at the 5 percent level.

** statistically significant at the 1 percent level.

Table 8

Estimated Effects of Affiliation with BHCs on the Size of Capital Injection Ratios

Size of subsidiary bank (millions of dollars)	Size of BHCs (millions of dollars)		
	$1,000 ≥ Assets > $100	Assets > $1,000	
	Texas	Texas	Other
$25 ≥ Assets > 0	0.0167	0.0213	0.0165
$50 ≥ Assets > $25	0.0054	0.0101	0.0165
$75 ≥ Assets > $50	0.0052	0.0098	0.0165
Assets > $75	0.0034	0.0081	0.0086

dependent bank.[17] While this paper presents no criterion for economic significance, these effects are too large to be dismissed as economically insignificant.

Holding Company Affiliation's Influence on the Incidence of Bank Failure

The influence of RHCS on capital injections affects how one interprets some recent studies of the determinants of bank failure. Belongia and Gilbert (1990) find that increases in RHCS reduce the probability of bank failure. Gajewski (1989) reports a similar finding: the larger the number of bank subsidiaries in a BHC, the lower the probability of failure by its subsidiary banks. This study indicates that the lower probability of failure by bank subsidiaries of large, multibank holding companies results, in part, from the larger capital injections by multibank holding companies into their troubled banks.

CONCLUSION

The Federal Reserve Board expects BHCs to serve as sources of strength for their bank subsidiaries. BHCs can do so by injecting capital into their troubled subsidiaries when losses reduce their capital ratios below levels acceptable to bank supervisors.

This paper examines whether BHCs have injected relatively more capital into their troubled subsidiaries than the owners of similarly troubled independent banks, holding constant the values of other determinants of capital injections. The empirical results indicate that the BHC effect depends on the total banking assets of the BHCs as well as the assets of their troubled bank subsidiaries. BHCs with total assets that are at least 50 times larger than those of their troubled subsidiaries tend to inject more capital into those subsidiaries than other bank owners inject into their banks.

These results are consistent with the view that BHCs weigh the effects of capital injections on their reputations in the financial markets, and with the Board, against the opportunity cost of such injections. The results are also consistent with recent studies which found that the subsidiaries of relatively large BHCs have a lower probability of failure than other banks with similar characteristics—their lower failure rate reflects large capital injections into such banks.

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[17]The estimate of the size of the extra capital injection due to affiliation with a BHC in this case also can be calculated using the results in table 5. The bank subsidiary has total assets of $15 million. Suppose the BHC has total assets of $750 million. Results from table 5 indicate that this Texas bank subsidiary would receive an extra capital injection of $202,808 because of its affiliation with the BHC. This amount equals 0.0468 (coefficient on RHCS 100) times 0.2889 (predicted probability of INJ > 0) times $15 million.

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